DRAFT FINAL
EXPANDED ENGINEERING EVALUATION/COST ANALYSIS (EEE/CA)
FOR THE
McLAREN TAILINGS SITE
COOKE CITY, MONTANA

Engineering Services Agreement DEQ/MWCB 401027
Task Order Number 05

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9.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides a comparison of the reclamation alternatives retained for the McLaren Tailings Site. The comparison focuses mainly on the following criteria: 1) the relative protectiveness of human health and the environment that would be provided by the alternatives; 2) the long-term effectiveness that would be provided by the alternatives; and 3) the estimated attainment of ARARs for each alternative. Modeling results are used in the comparisons to contrast the two threshold criteria of "overall protection of human health and the environment" and "compliance with ARARs" for each alternative. The primary balancing criteria are also compared; however, the evaluation of each of these criteria is very similar due to the technical similarities in the alternatives themselves, with the exception of costs. Table 9-1 presents a summary of the alternatives with respect to the first seven NCP evaluation criteria.

Of the alternatives retained for the site, Alternatives 5a, 5b and 6 provide the greatest overall protectiveness of human health and the environment. Alternative 6 is expected to provide approximately 2 to 3 percent greater risk reduction compared to Alternatives 5a and 5b, respectively; however, at a significantly higher cost.

Alternatives 5a, 5b and 6 are expected to provide adequate risk reduction to human health over the long term to meet the requirements of the risk assessment for the residential use scenario; additionally, each of these alternatives is expected to provide adequate ecological risk reduction to meet the requirements of the ecologic risk assessment.

Alternatives 5a, 5b and 6 are expected to achieve compliance with all groundwater and surface water chemical-specific ARARs (water quality). Additionally, each of these alternatives would comply with all action-specific and location-specific ARARs.

Alternative 6 is the only alternative that would permanently remove wastes from the site (approximately 267,200 cubic yards of tailings and waste rock disposed of in an off-site repository), and this is the most costly of all of the alternatives considered for the site. Under none of the remaining alternatives would the wastes actually be treated to reduce contaminant volume or toxicity; however, each of the alternatives would provide varying degrees of reduction in contaminant mobility. In general, the greater the reduction in contaminant mobility provided by a specific alternative, the greater the cost.

The short-term effectiveness is expected to be similar for each of the alternatives. The alternatives are all technically similar, and the construction steps required to implement them would be similar as well. It is anticipated that any of the alternatives could likely be completed in a single construction season (Alternative 6 may take longer). Short-term impacts to the surrounding community may be appreciable considering the proximity of the site to Cooke City, which has a relatively small resident population but receives considerable tourist traffic throughout most of the year. Short-term impacts to the surrounding community would involve increased local vehicle traffic and associated safety hazards, as well as increased noise levels and dust generation. Additional air quality impacts would likely be applicable to Alternatives 5a, 5b,

TABLE 9-1: COMPARATIVE ANALYSIS OF ALTERNATIVES

Assessment Criteria	**Alternative 1:** No Action	**Alternative 4:** In-Place Containment	**Alternative 5a:** On-Site Disposal in a Fully Encapsulated Repository	**Alternative 5b:** On-Site Disposal in an Un-Lined Repository with a Multi-Layered Cap	**Alternative 5c:** On-Site Disposal in a Constructed Repository with a Soil Cover	**Alternative 6:** Off-Site Disposal in a Nearby Mine Waste Repository
Overall Protectiveness of Public Health, Safety, and Welfare -	No reduction in risk.	Containment and stabilization of sources is expected to reduce human exposure risk by 77% overall.	Containment of wastes in a fully encapsulated repos is expected to reduce human exposure risk by 97% overall.	Containment of tailings in a repository is expected to reduce human exposure risk by 96% overall.	Containment of tailings in a repository is expected to reduce human exposure risk by 89% overall.	Off-site disposal of all wastes is expected to reduce human exposure risk by 100%.
Environmental Protectiveness -	No protection offered.	Containment and stabilization of sources is expected to reduce ecological exposure risk by 80% overall.	Containment of wastes in a fully encapsulated repos is expected to reduce ecological exposure risk by 98% overall.	Containment of tailings in a repository is expected to reduce ecological exposure risk by 98% overall.	Containment of tailings in a repository is expected to reduce ecological exposure risk by 92% overall.	Off-site disposal of all wastes is expected to reduce ecological exposure risk by 100%.
Compliance with ARARs -						
Chemical Specific	All chemical-specific ARARs would be met.	HHS for Mn in on-site GW not attained. HHS for Fe in on-site SW not attained.	All chemical-specific ARARs would be met.	All chemical-specific ARARs would be met.	HHS for Mn in on-site GW not attained.	All chemical-specific ARARs would be met.
Location Specific	None Apply	All location-specific ARARs would be met.	All location-specific ARARs would be met.	All location-specific ARARs would be met.	All location-specific ARARs would be met.	All location-specific ARARs would be met.
Action Specific	None Apply	All action-specific ARARs would be met.	All action-specific ARARs would be met.	All action-specific ARARs would be met.	All action-specific ARARs would be met.	All action-specific ARARs would be met.
Long-Term Effectiveness and Permanence -		79% risk reduction expected overall.	98% risk reduction expected overall.	97% risk reduction expected overall.	91% risk reduction expected overall.	100% risk reduction expected overall.
Magnitude of Residual Risk	No reduction in CoC levels in any environmental media, except by natural degradation/erosion.	Level of risk reduction would attain recreational user compliance for the site.	Level of risk reduction would attain residential user compliance for the site.	Level of risk reduction would attain residential user compliance for the site.	Level of risk reduction would attain residential user compliance for the site.	Level of risk reduction would attain residential user compliance for the site.
Adequacy and Reliability of Controls	No controls over any on-site contamination. Potential for catastrophic failure of tailings dam.	Containment controls are adequate for intended purposes; however, long-term reliability is questionable due to physical location of tailings. Potential for catastrophic failure of tailings dam would remain (though risk would be reduced).	Primary sources of concern would be removed and effectively isolated from human and environmental receptors.	Primary sources of concern would be removed and effectively isolated from human and environmental receptors.	Primary sources of concern would be removed and effectively isolated from human and environmental receptors.	Primary sources of concern would be permanently removed from the site. Very reliable.
Reduction of Toxicity, Mobility, and Volume - Treatment Process Used and Materials Treated	None.	In-place containment via cover and revegetation to reduce mobility of CoCs. Future impacts to SW (Soda Butte Creek and Miller Creek) possible due to physical location of tailings.	Removal and containment of primary sources of concern expected to provide significant reduction in mobility of CoCs for all pathways.	Removal and containment of primary sources of concern expected to provide significant reduction in mobility of CoCs for all pathways.	Removal and containment of primary sources of concern expected to provide significant reduction in mobility of CoCs for all pathways.	Complete removal of all waste sources expected to provide significant reduction in mobility of CoCs for all pathways.
Volume of Contaminated Materials Treated	No reduction in CoC toxicity, mobility, or volume.	Only exposed surfaces would be treated.	No volume actively treated; however, approx. 267,200 cy removed from sensitive area and isolated from human and environmental receptors.	No volume actively treated; however, approx. 267,200 cy removed from sensitive area and isolated from human and environmental receptors.	No volume actively treated; however, approx. 267,200 cy removed from sensitive area and isolated from human and environmental receptors.	No volume actively treated; however, approx. 267,200 cy permanently removed from the site.
Expected Degree of Reduction	Minimal, via natural degradation only. (potential for future increases in mobility of contaminants).	Volume of wastes would not be reduced; however, mobility of CoCs would be moderately reduced.	Vol. or tox. of CoCs not reduced; however, significant reduction in mobility expected.	Vol. or tox. of CoCs not reduced; however, significant reduction in mobility expected.	Vol. or tox. of CoCs not reduced; however, significant reduction in mobility expected.	On-site volume of waste reduced by 212,000 cy; reduction in mobility of remaining waste also expected.
Short-Term Effectiveness - Protection of Community During Reclamation Action	Not applicable.	Fugitive emissions control may be required during construction.	Fugitive emissions control may be required during construction.	Fugitive emissions control may be required during construction.	Fugitive emissions control may be required during construction.	Fugitive emissions control may be required during construction.
Protection of On-Site Workers During Reclamation Action	Not applicable.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.
Environmental Impacts	Same as baseline conditions.	Environmental (SW) impacts possible due to waste treatment activities near active stream channels and floodplains.	Environmental (SW) impacts possible due to waste treatment activities near active stream channels and floodplains.	Environmental (SW) impacts possible due to waste treatment activities near active stream channels and floodplains.	Environmental (SW) impacts possible due to waste treatment activities near active stream channels and floodplains.	Environmental (SW) impacts possible due to waste treatment activities near active stream channels and floodplains.
Time Until Reclamation Action Objectives are Achieved	Not applicable.	One field season.	One field season.	One field season.	One field season.	One or two field seasons.
Implementability - Ability to Construct and Operate	No construction or operation involved.	Moderately difficult to implement due to location and need to work with wet tailings.	Moderately difficult to implement due to location and need to work with wet tailings.	Moderately difficult to implement due to location and need to work with wet tailings.	Moderately difficult to implement due to location and need to work with wet tailings.	Moderately difficult to implement due to location and need to work with wet tailings.
Ease of Implementing More Action if Necessary	Not applicable.	Easily implementable (additional armoring/ stabilization, etc.) if determined to be necessary.	Easily implementable (additional repos. capacity available) if determined to be necessary.	Easily implementable (additional repos. capacity available) if determined to be necessary.	Easily implementable (additional repos. capacity available) if determined to be necessary.	Easily implementable (additional repos. capacity available) if determined to be necessary.
Availability of Services and Capacities	Not applicable.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.
Availability of Equipment and Materials	Not applicable.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.	Available locally and within the state.
Estimated Capital Cost	**$0.00**	**$2,709,112.00**	**$4,686,721.00**	**$4,170,877.00**	**$3,720,031.00**	**$7,107,655.00**

5c and 6, compared to the other alternatives, due to the need to excavate and haul a greater volume of material.

Each of the proposed alternatives may have short-term impacts to Soda Butte Creek (and possibly Miller Creek). Short-term impacts would likely be more prevalent under Alternatives 5a, 5b, 5c and 6 due to the need to work in close proximity to the streams and/or excavate wastes from the floodplains. Additionally, several of the alternatives may require installation of a surface water diversion structure in Soda Butte Creek to allow reconstruction of the Soda Butte Creek stream channel through the existing footprint of the tailings impoundment. However, the existing by-pass channel that runs on the north side of the tailings impoundment could likely be utilized as a diversion to convey the majority of the flow of Soda Butte Creek and Miller Creek while the channel is reconstructed.

Short-term impacts to environmental resources are difficult to quantify; however, every effort would be made to minimize impacts to Soda Butte Creek and potential downstream receptors during implementation of any of the alternatives. Complete or partial excavation of the tailings impoundment would expose un-weathered (reduced) tailings materials to water and oxygen that could potentially result in an increased production of ARD over the short term. To minimize this possibility, the newly exposed tailings would be isolated from excess water to the extent practical via dewatering during the excavation process. Dewatering would likely consist of construction of a series of trenches and sumps, and installation of pumps to remove excess water from the immediate excavation area. The exact dewatering method to be employed would be determined during the detailed design phase of the project. Application for water quality permits, required as part of State and Federal Agency approval of the reclamation plan, would also aid in planning for protecting Soda Butte Creek from short-term impacts during the construction phase of the project. Additionally, Best Management Practices (BMPs) would be required to be implemented during construction to protect surface water resources.

The implementability of most of the alternatives is expected to be similar. All of the alternatives use conventional design and construction techniques; however, the construction steps required to implement any of the alternatives are considered moderately difficult due to the need to work with wet tailings. Alternative 6 may not be implementable due to public opposition. Alternative 6 may have the greatest potential to be rejected by the public considering impacts to traffic patterns in the area.

For ease of construction, Alternative 5c would probably be the easiest alternative to implement because the tailings impoundment would simply be completely excavated, loaded out, and transported to the repository without involving the use of specialized materials for the construction of a repository. Although Alternative 4 involves handling a much smaller quantity of material, operating equipment and establishing stable side slopes on the exposed (and potentially wet) tailings may be problematic. Additionally, installation of a very large concrete culvert through the tailings dam under Alternative 4 may present some construction challenges. Any of the alternatives would require the import of a significant amount of organic material and lime and development/management of a borrow area; materials availability and scheduling of

delivery may make any alternative somewhat difficult to implement.

Table 9-1 indicates the estimated total costs associated with each alternative. Of the various alternatives considered for the site, Alternative 4 is the least costly to implement; however, Alternative 4 is expected to be the most long-term maintenance intensive of all of the proposed alternatives. The inlet of the culvert installed through the tailings dam under Alternative 4 would be prone to plugging during high runoff events and would likely need to be cleaned out several times per year. Additionally, the riprap armoring installed along the banks of the constructed channels within the tailings footprint may require replenishment or reinforcement after major flood events. The riprap armoring is a very important component of Alternative 4 because it is intended to prevent Miller Creek and Soda Butte Creek flows from scouring and eroding the reclaimed side slopes of the channels, which would actually be recontoured and covered mill tailings under Alternative 4. Although Alternative 4 would aid in dehydrating and stabilizing the tailings impoundment, the tailings impoundment would remain in the valley bottom of the Soda Butte Creek drainage; consequently, the risk of catastrophic failure of the tailings dam would not be eliminated.

Alternative 5a is also expected to be maintenance intensive over the long term. Under Alternative 5a, the leachate storage tank would need to be routinely monitored to determine pumping frequency. Additionally, the collected leachate would need to be sampled and analyzed to determine appropriate disposal options. A leachate collection system would not be necessary under Alternatives 5b or 5c (the other repository alternatives) due to the lack of a bottom liner system. The monitoring and maintenances issues associated with Alternatives 4 and 5a would need to be resolved prior to implementing either of these alternatives.

Alternatives 5a, 5b, and 6 are the only alternatives that would comply with the risk reduction goals for the site, and are also expected to attain all water quality ARARs. Of these three alternatives, Alternative 6 is significantly more expensive than the others. Table 9-2 summarizes the estimated cost per unit risk reduction for each alternative.

TABLE 9-2
ALTERNATIVE COST EFFECTIVE COMPARISON SUMMARY

Alternative	Overall Risk Reduction	Estimated Cost	Cost per 1% Reduction in Risk
Alternative 4	79%	$2,709,112	$34,293
Alternative 5a	98%	$4,686,721	$47,824
Alternative 5b	97%	$4,170,877	$42,999
Alternative 5c	91%	$3,720,031	$40,879
Alternative 6	100%	$7,107,655	$71,077

Table 9-2 shows that there is a relatively wide range in overall risk reduction and cost effectiveness provided by each of the alternatives. At first glance, it appears that Alternative 4 is the most cost effective alternative, providing the greatest risk reduction for each dollar spent. However, Alternative 4 is expected to be the most maintenance intensive of all of the alternatives considered for the site. Additionally, although Alternative 4 would aid in dehydrating and stabilizing the tailings impoundment, the tailings would remain directly in the valley bottom and floodplain of Soda Butte Creek; consequently, the risk of catastrophic failure of the tailings dam would not be eliminated.

According to the analysis presented on Table 9-2, Alternative 5c is the next most cost effective alternative considered for the site. However, Alternative 5c would not comply with the risk reduction goals for the site, and is also not expected to attain all water quality ARARs. Alternative 5b is the third most cost effective alternative considered for the site, and would comply with the risk reduction goals for the site. Additionally, Alternative 5b is expected to attain all water quality ARARs.